(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 November 2002 (14.11.2002)

PCT

(10) International Publication Number
WO 02/089693 A2

(51) International Patent Classification⁷: A61C 7/02

(21) International Application Number: PCT/US02/09896

(22) International Filing Date: 29 March 2002 (29.03.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/848,030 3 May 2001 (03.05.2001) US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU,*

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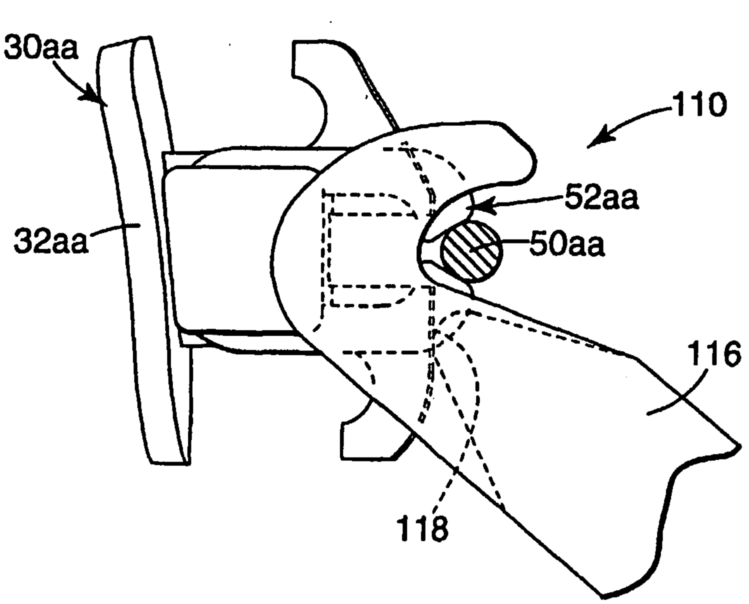
(54) Title: METHOD AND INSTRUMENT FOR RELEASING AN ORTHODONTIC ARCHWIRE FROM AN ORTHODONTIC APPLIANCE



(57) Abstract: A method and hand instrument are provided for releasing an archwire from an archwire slot of an orthodontic appliance that has a latch. In the method, at least one leg of the hand instrument is placed along a tooth-facing side of the archwire and the instrument is manipulated in order to urge the archwire in a direction toward the latch. The archwire is pressed against the latch with sufficient force to open the latch and release the archwire from the archwire slot. The hand instrument preferably includes two legs with a cam section located between the legs. The cam section contacts the appliance while a shaft of the instrument is rocked in order to press the archwire against the latch.

WO 02/089693 A2

SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

METHOD AND INSTRUMENT FOR RELEASING AN ORTHODONTIC ARCHWIRE FROM AN ORTHODONTIC APPLIANCE

Background of the Invention

1. Field of the Invention

This invention relates to a method for disengaging an orthodontic archwire from an archwire slot of an orthodontic appliance, as well as an instrument for carrying out the method.

2. Description of the Related Art

Orthodontic therapy is a specialized type of treatment within the field of dentistry, and involves movement of malpositioned teeth to orthodontically correct locations. Orthodontic treatment often improves the patient's occlusion and typically enhances the aesthetic appearance of the teeth.

Many types of orthodontic treatment programs involve the use of a set of tiny appliances and wires that are commonly known collectively as "braces". During such treatment programs, small appliances known as brackets are fixed to the patient's anterior, cuspid and bicuspid teeth, and an archwire is inserted into a slot of each bracket. The archwire forms a track to guide movement of the teeth to orthodontically correct locations. End sections of the archwires are typically captured in tiny appliances known as buccal tubes that are fixed to the patient's molar teeth.

Many types of orthodontic brackets have archwire slots that are open on one side for insertion of the archwire, and bounded on remaining sides by walls or other structure. Brackets that are intended to be bonded to the patient's front tooth surfaces often have archwire slots that are open either on a buccolabial side (i.e., a side facing the patient's cheeks or lips) or an occlusal side (i.e., a side facing the outer tips of the teeth) of the archwire slot. Some brackets, however, are intended to be fixed to the lingual side of the patient's teeth (i.e., the side of the teeth facing the patient's tongue) and in that instance typically have an archwire slot that is open on a lingual side or on an occlusal side.

Many orthodontists use ligatures to connect the archwire to the brackets and to urge the archwire into an orientation of seating engagement in the archwire slot. One type of commercially available orthodontic ligature is a small, elastomeric O-ring. Orthodontic O-rings are installed by stretching the O-ring around small wings (known as "tiewings") that are connected to the bracket body on the gingival side (i.e., the side facing the patient's gingiva or gums) and on the occlusal side of the archwire slot. Once installed, the O-ring ligature extends around the tiewings as well as over the labial side of the archwire and urges the archwire toward a fully seated position in contact with a lingual wall of the archwire slot.

Metal ligatures, such as ligatures made of stainless steel, are also used to retain archwires in archwire slots of brackets. Metal ligatures are typically made of a short section of initially straight wire. During installation, the wire ligature is hooked around the tiewings and extended over the labial side of the archwire. End sections of the ligature are then twisted together to form a loop to retain the ligature in place.

Unfortunately, some orthodontists are not entirely satisfied with elastomeric and metal ligatures. Such ligatures are somewhat time-consuming to install, both during initial installation and also during reinstallation whenever replacement of the archwire or ligatures is desired. As can be appreciated, a savings in the amount of time needed for ligation can help to reduce the total time that the practitioner must spend with the patient and consequently aid in reducing the overall costs of orthodontic treatment.

Other disadvantages are also associated with elastomeric and metal ligatures. For example, there have been reports that certain polyurethane elastomeric ligatures have exhibited deformation and force decay during the course of treatment. In some instances, elastomeric ligatures are stained by food and beverages consumed by the patient and become somewhat unsightly. Metal ligatures often have sharp ends that may retain plaque and food debris and also may increase the risk of infection.

In an effort to overcome the problems associated with conventional ligatures, a variety of orthodontic brackets have been proposed having various types of latches for coupling the archwire to the bracket. Such brackets are also known as self-ligating brackets. The latch comprises a clip, spring member, cover, shutter, bail or other structure that is connected to the bracket body for retaining an archwire in the archwire slot.

Examples of self-ligating orthodontic brackets having generally U-shaped ligating latch clips are described in U.S. Patent Nos. 3,772,787, 4,248,588 and 4,492,573. In general, the clip of such brackets is slidably mounted on the bracket body, and a dental explorer or other small-tipped dental tool is used to move the clip relative to the body when needed in order to open or close the archwire slot. A self-ligating bracket known as the "Speed" brand bracket also has a movable, generally U-shaped clip for ligating the archwire to the bracket.

Other types of self-ligating brackets have latches that resemble swinging shutters or closures that pivotally move between a slot-open and a slot-closed position. For example, U.S. Patent No. 4,712,999 has a rotatable cover plate that is pivotally connected at one end to a tiewing of the bracket along one side of the slot, and is releasably engagable at the other end with a tiewing that is located along the opposite side of the archwire slot. Other orthodontic brackets with swinging latches are described in U.S. Patent Nos. 4,103,423, 5,516,284 and 5,685,711.

U.S. Patent Nos. 4,371,337 and 4,559,012 describe self-ligating orthodontic brackets having latches that rotate about the longitudinal axis of the archwire slot. The latch of these references has a somewhat cylindrical shape and is rotatably received in a mating, cylindrical channel, and an outwardly extending arm is provided to assist in rotatably moving the latch between a slot-open and a slot-closed position.

A self-ligating orthodontic bracket that is described in U.S. Patent No. 5,711,666 has a latch that comprises a flexible flat spring member. One end of the spring member is fixed to the bracket body on one side of the archwire slot, and the opposite end of the spring member has notches that releasably engage latch sears or catches when the spring member is moved to a slot-closed position. To open the slot, the notches are disengaged from the catches and the spring member is bent to an orientation sufficient to enable the archwire to be removed from the archwire slot.

Other types of self-ligating orthodontic brackets have latches that comprise essentially flat plates that are slidable between a slot-open and a slot-closed position. Examples of such construction are shown in U.S. Patent Nos. 5,094,614, 5,322,435 and

5,613,850. In general, the sliding latches described in those references move in upright channels that are located buccolabially of the archwire slot.

Another type of self-ligating bracket that has been proposed in the past has a latch that is made of a section of wire material that functions similar to a bail. The orthodontic brackets described in U.S. Patent Nos. 4,149,314, 4,725,229 and 5,269,681 have wire-like latches that swing between a slot-closed position and a slot-open position. The orthodontic bracket described in U.S. Patent No. 4,260,375 has a wire latch that is slidable between a slot-open and a slot-closed position.

A new orthodontic appliance is described in U.S. Patent No. 6,302,688 and has a latch for retaining an archwire in an archwire slot. The latch releases the archwire from the archwire slot whenever the archwire exerts a force on the appliance that exceeds a certain minimum value. The minimum value is less than about one-half of the force required in the same direction to debond the appliance from the tooth, and thus reduces the likelihood that the appliance will unintentionally debond from the tooth during the course of orthodontic treatment.

Summary of the Invention

The present invention is directed toward a method of releasing an archwire from an archwire slot of an orthodontic appliance. The method includes the act of placing at least one leg of a hand instrument along a tooth-facing side of the archwire. The method also includes the act of manipulating the hand instrument in order to urge the archwire in a direction toward a latch of the appliance. The method further includes the act of pressing the archwire against the latch with sufficient force to open the latch and release the archwire from the archwire slot.

The present invention is also directed toward an orthodontic hand instrument for releasing an archwire from an archwire slot of an orthodontic appliance having a latch. The instrument comprises an elongated shaft and two legs connected to the shaft. Each leg has a hook-shaped configuration for engaging the archwire and the legs are spaced apart from each other. The instrument also includes a cam section located between the legs for contacting the appliance while the shaft is rocked in order to press the archwire against the latch of the appliance.

Further details of the invention are defined in the features of the claims.

Brief Description of the Drawings

Fig. 1 is a perspective view of an exemplary orthodontic appliance for use with the method and instrument of the present invention along with a fragmentary view of an archwire received in an archwire slot of the appliance;

Fig. 2 is an end elevational view in partial cross-section looking toward a mesial side of the appliance and archwire of Fig. 1;

Fig. 3 is a side elevational view of a hand instrument of the present invention releasing the archwire from the archwire slot of the appliance shown in Figs. 1 and 2;

Fig. 4 is an enlarged, fragmentary side elevational view of a front portion of the hand instrument shown in Fig. 3;

Fig. 5 is an enlarged, fragmentary elevational view taken along another side of the front portion of the hand instrument depicted in Fig. 4;

Fig. 6 is an enlarged fragmentary side elevational view of a front portion of the hand instrument illustrated in Figs. 3-5 along with an exemplary orthodontic appliance, wherein the hand instrument is shown as it might appear after it is brought into position for release of the archwire from the archwire slot of the appliance;

Fig. 7 is a view somewhat similar to Fig. 6 except that the hand instrument has been moved in an arc in order to release the archwire from the archwire slot;

Fig. 8 is a fragmentary perspective view of a front portion of a hand instrument for releasing an archwire from an orthodontic appliance according to another embodiment of the invention;

Fig. 9 is a perspective view of a hand instrument for releasing an archwire from an orthodontic appliance according to still another embodiment of the invention;

Fig. 10 is a fragmentary perspective view of a front portion of a hand instrument for releasing an orthodontic archwire from an orthodontic appliance according to still another embodiment of the invention;

Fig. 11 is a fragmentary perspective view illustrating an example of use of the hand instrument shown in Fig. 10 during release of an archwire from an archwire slot of an orthodontic appliance;

Fig. 12 is a view somewhat similar to Fig. 3 except showing a hand instrument according to another embodiment of the invention; and

Fig. 13 is an enlarged, fragmentary elevational view in partial section taken along a front portion of the hand instrument depicted in Fig. 12.

Detailed Description of the Preferred Embodiments

An orthodontic appliance constructed in accordance with one of the embodiments shown in U.S. Patent No. 6,302,688 is illustrated in Figs. 1-2 and is broadly designated by the numeral 30. The appliance 30 in this instance is an orthodontic bracket adapted to be secured to the buccolabial surface of a patient's tooth. Alternatively, the appliance could be a buccal tube or any other orthodontic appliance that is adapted to receive an archwire for controlling movement of the teeth during the course of orthodontic therapy.

The appliance 30 includes a base (not shown) for bonding the appliance 30 directly to the patient's tooth enamel by use of an adhesive. Preferably, the base has a concave compound contour that matches the convex compound contour of the patient's tooth surface. A body 34 extends outwardly from the base in a generally buccolabial direction. The body 34 includes an outermost mesial side as well as an outermost distal side.

An archwire slot 40 extends across the body 34 in a generally mesial-distal direction. The archwire slot 40 includes an occlusal side that is defined in part by a flat occlusal wall portion that is fixed to the body 34. The archwire slot 40 also has a gingival side that is defined in part by a flat gingival wall portion that is also fixed to the body 34. The appliance 30 includes a mesial archwire slot relief area 46 and a distal archwire slot relief area 48. The relief areas 46, 48 are optional, but advantageously provide greater interbracket width and enhanced control over movement of the tooth as described in U.S. Patent No. 4,531,911.

The appliance 30 also includes a latch 52 that is connected to the body 34 for releasably retaining the archwire 50 in the archwire slot 40. The latch 52 comprises a mesial spring clip 68 and a distal spring clip 70. The mesial spring clip 68 is fixed to a mesial side of a body 34 of the appliance 30, while the distal spring clip 70 is fixed to a distal side of the appliance body 34.

The clips 68, 70 have an overall, generally "C"-shaped configuration and each includes a pair of arm portions 54h that extend toward each other. Preferably, each of the spring clips 69, 70 is received in a sleeve 72. The sleeve 72 is preferably fixed to a body 34 of the appliance 30 by a brazing or welding (including laser welding) process. The clip 68 and one sleeve 72 constitute a mesial assembly, and the clip 70 and the other sleeve constitute a distal assembly.

The sleeves 72 are an advantage because the spring clips 68, 70 may be made of a material that is difficult to weld or braze to the body 34. For example, the clips 68, 70 may be made of a resilient shape-memory alloy such as near-stoichiometric nitinol, while the body 34 may be made of an alloy of stainless steel. In that instance, the sleeve 72 may be also made of an alloy of stainless steel that can be readily welded or brazed to the body 34 according to conventional welding or brazing techniques. The sleeve 72 thus serves to couple the spring clips 68, 70 to the body 34.

The clips 68, 70 including the arm portions 54 are sufficiently resilient to enable an archwire 50 to be inserted into an archwire slot by urging the archwire 50 in a lingual direction into the space within the confines of the clips 68, 70. As the archwire 50 engages the arm portions 54, the clips 68, 70 self-deflect and spread open a distance sufficient to enlarge the space between the arm portions 54 and allow the archwire 50 to pass through that space. Once the archwire 50 is received within the confines of the clips 68, 70, the clips 68, 70 spring back to their normal orientation as shown in Figs. 17 and 18 to retain the archwire 50 in the archwire slot.

The clips 68, 70 including the arm portions 54 are sufficiently stiff to retain the archwire 50 in the archwire slot during the course of treatment so long as forces exerted by the archwire 50 on the appliance 30 are below a certain minimum value in a generally buccolabial direction (more particularly, in a direction opposite to the direction of insertion of the archwire 50 into the archwire slot). However, whenever the forces exerted by the archwire 50 on the appliance 30 in the same direction are greater than the minimum value, as might occur when unexpectedly high forces are encountered, the arm portions 54 deflect outwardly and the clips 68, 70 open to enable the archwire 50 to be released from the archwire slot. In this manner, the appliance 30 does not unintentionally debond from the tooth when unexpected, relatively high forces are encountered.

The shape of the outer ends of the arm portions 54 may be modified to enhance insertion or release of the archwire 50 as desired. For example, the outer, buccolabial corners of the arm portions 54 may be curved or tapered to facilitate spreading the clips 68, 70 apart during insertion of the archwire 50 into the archwire slot. However, to ensure that the arm portions 54 do not spread apart until forces exerted by the archwire 50 exceed the minimum value, the facing end sections of the arm portions 54 may be cut at an angle or extended toward each other as needed.

The arm portions 54 deflect outwardly to a slot-open position whenever the force exerted by the archwire 50 on the arm portions 54 exceeds a certain minimum value. The minimum value is sufficiently high to prevent the archwire 50 from unintentionally releasing from the archwire slot 40 during the normal course of orthodontic treatment. As such, the archwire 50 can exert forces on the appliance 30 sufficient to carry out the treatment program and move the associated tooth as desired. Preferably, the arm portions 54 release the archwire 50 from the archwire slot 40 in a generally buccolabial direction whenever the archwire exerts a force in the same direction on the appliance that is in the range of about 0.2 lb (0.1 kg) to about 11 lb (5 kg), more preferably in the range of about 0.4 lb (0.2 kg) to about 5.5 lb (2.5 kg), and most preferably in the range of about 0.4 lb (0.2 kg) to about 2.7 lb (1.25 kg).

Whenever the force exerted by the archwire 50 on the appliance 30 exceeds the selected minimum value, the arm portions 54 self-deflect outwardly to release the archwire 50 from the archwire slot 40. For example, if the archwire 50 has a relatively large transverse cross-sectional area and is deflected from its normal shape a substantial distance in order to be inserted into the archwire slot 40 (as may occur when the tooth bonded to the appliance 30 is severely maloccluded and located a substantial distance from adjacent teeth), the arm portions 54 will deflect outwardly as soon as the archwire 50 is placed in the archwire slot 40 and pressure by the practitioner in a lingual direction on the archwire 50 is released. As a consequence, the arm portions 54 of the latch 52 substantially preclude the archwire 50 from exerting a force on the appliance 30 that is greater than the minimum value as mentioned above.

To determine the force to release the latch 52, a section of archwire is selected having an area in longitudinally transverse sections that is complemental to (i.e., substantially fills) the cross-sectional area of the archwire slot 40. Next, a sling is constructed and is connected to the archwire section closely adjacent but not in contact with the mesial side 36 and the distal side 38. Optionally, the sling is welded or brazed to the archwire section. Next, the sling is pulled away from the appliance 30 while the appliance 30 is held in a stationary position, taking care to ensure that the longitudinal axis of the archwire section does not tip relative to the longitudinal axis of the archwire slot 40. The force to release the latch 52 is determined by use of an Instron testing apparatus connected to the sling, using a crosshead speed of 0.5 in/min. (1.3 cm/min.).

Preferably, the minimum value for self-release (i.e., self-opening) of the latch 52 is substantially less than the force required in the same direction to debond the appliance 30 from the associated tooth. The minimum value for self-release of the latch 52 is more preferably less than about one-half of the force required in the same direction to debond the appliance 30 from the associated tooth. For example, if the expected bond strength of the adhesive bond between the appliance 30 and the associated tooth is 16 lbs. (7.3 kg) in a buccolabial direction, the latch 52 is constructed to self-release the archwire 50 whenever the archwire 50 exerts a force in the same buccolabial direction on the appliance 30 that is somewhat greater than about 8 lbs. (3.6 kg).

The self-releasing latch 52 is a benefit to the practitioner, in that the likelihood of spontaneous debonding of the appliance 30 is substantially reduced. For example, if the practitioner attempts to place a relatively large archwire in the archwire slot 40 and the latch 52 self-releases as soon as the practitioner releases the archwire, the practitioner can then use an archwire with less stiffness in its place. As another example, if the archwire 50 is initially held in the archwire slot 40 by the arm portions 54 and the archwire 50 subsequently exerts a larger force on the appliance 30 (as may occur, for example, when the archwire 50 encounters a hard object such as when the patient is chewing relatively hard food), the arm portions 54 will deflect outwardly to their slot-open position to release the archwire 50 so that the appliance 30 does not debond from the tooth. Treatment can then be resumed by merely replacing the archwire 50 in the archwire slot 40 without the need to rebond the base 32 to the associated tooth.

Preferably, the distance between the opposed ends of each pair of arm portions 54 is less than the overall occlusal-gingival dimension of the smallest archwire expected to be used during the course of treatment. The archwire 50 need not fill the archwire slot 40 and flatly engage the wall portions 42, 44 in all instances. For example, a somewhat smaller wire, and perhaps a wire having a circular cross-sectional shape, may be used during a portion of the treatment program. The distance between the opposed ends of each pair of spring members 56 is preferably selected so that a variety of archwires of different cross-sectional configurations may be used in connection with the appliance 30.

When an archwire having a relatively large cross-sectional area is placed in the archwire slot 50, the deformable nature of the resilient spring member 56 provides active treatment and facilitates movement of the associated tooth while the appliance 30 moves along the archwire 40. During such movement, the resilient spring member 56 urges the archwire 50 in a direction toward the arm portions 54 and toward a position of flat contact with all four of such arm portions 54. As such, the spring member 56 helps to move the associated tooth to position selected by the practitioner, since the inherent bias of the spring member 56 contributes to the forces exerted on the associated tooth.

Optionally, the appliance 30 includes one or more tiewings or tiewing portions 62. The appliance 30 as illustrated has four tiewings portions 62, each of which is integrally connected to the body 34.

The tiewing portions 62 provide an alternative method of connecting the archwire 50 to the appliance 30. For example, if the archwire 50 cannot be fully inserted into the archwire slot 40 without undue force, the archwire 50 may be ligated to the appliance 30 by passing a ligature around one or more of the tiewing portions 62 as well as around a portion of the archwire 50 without fully seating the archwire 50 in the archwire slot 40. As the associated tooth moves toward a position of alignment with adjacent teeth and closer to the archwire slot 40 over a period of time, less force is needed to fully seat the archwire 50 in the archwire slot 40. At that time, the ligature may then be removed and the archwire 50 retained in the archwire slot 40 by means of the latch 52.

Optionally, the spring clips 68,70 are cut from a flat section of metallic stock material. Suitable metallic materials include shape memory alloys such as alloys of nitinol and beta-titanium. The spring clips may be cut from the stock material using a stamping, die cutting, chemical etching, EDM, laser cutting, or water jet cutting process. As another option, the clips 68,70 could be formed and then heat treated to set their shapes.

The clips 68,70 may be made from flat, annealed superelastic material having a pickled surface. The nitinol has a nickel content of 55.97 percent by weight and an A_f of 10° ± 5° C. The nitinol is cold worked to 37.5% and has a thickness in the range of about 0.012 inch (0.3 mm) to about 0.016 inch (0.4 mm). The clip is first cut in a rough cutting EDM process, then cut along its edges for an additional one or more times using an EDM process in order to smooth the edges.

The clips 68,70 can be spread apart to different orientations in order to accommodate wires having different cross-sectional shapes. The clips 68,70 also have inherent memory to repeatedly spring back to a closed position, so that occlusal and gingival sides of the clips 68,70 are in contact with or closely adjacent the occlusal and gingival sides of the archwire respectively. Such construction provides better control over movement of the associated tooth.

Additionally, the clips 68,70 preferably have a shape that facilitates opening of the latch when the archwire is pushed against the clip in a lingual direction. For example, the labial side of the clips preferably extends at an angle relative to an occlusal-gingival reference axis, so that the clip or at least the arm portion of the clip tends to deflect in a lateral direction (such as in an occlusal or in a gingival direction) as the archwire is urged in a lingual direction in order to open the latch and admit the archwire into the archwire slot.

A hand instrument 110 according to one embodiment of the present invention is illustrated in Figs. 3-7. The hand instrument 110 is adapted to open the latch of an orthodontic appliance when desired in order to intentionally release an archwire from the archwire slot of the appliance.

As shown in Fig. 3, the hand instrument 110 includes an elongated shaft 112 with an outer end 114. The opposite end of the shaft 112 includes at least one leg for engaging an archwire and urging the archwire in a direction away from a base of the appliance. In the illustrated embodiment, the hand instrument 110 has two hook-shaped legs 116 having a generally "J"-shaped configuration.

The legs 116 of the hand instrument 110 are shown in more detail in Figs. 4 and 5. The legs 116 are spaced apart from each other and extend in parallel planes that lie on opposite sides of a central cam section 118 (Fig. 5). In this embodiment, the cam section 118 is located at a front end of the shaft 112, although other constructions are also possible.

Optionally, the legs 116 are stamped from sections of sheet metal and are connected by rivets 120 to a front portion of the shaft 112. The shaft 112 is preferably made of stainless steel.

An example of use of the hand instrument 110 is depicted in Figs. 6 and 7. Initially, the user manipulates the hand instrument 110 to an orientation such as shown in Fig. 6 in order to bring the legs 116 in a position along a tooth-facing side of an archwire 50aa. The distance between the legs 116 is sufficient to enable an orthodontic appliance 30aa to be received within the space between the legs 116.

As the legs 116 are placed along the tooth-facing side of the archwire 50aa, the cam section 118 of the hand instrument 110 comes into contact with the appliance 30aa as shown in Fig. 6. In this embodiment, the cam section 118 engages a labial side of at least one gingival tiewing of the appliance 30aa, although other constructions are possible. For example, the cam section 118 could be arranged to contact a base 32aa of the appliance 30aa.

Next, the shaft 112 of the hand instrument 110 is rocked in a generally occlusal-gingival direction. In Fig. 6, the shaft 118 of the hand instrument 110 is rocked in a gingival direction in an arc about the central longitudinal axis of the archwire 50aa as shown by the arrow, although an opposite orientation and direction of motion are also possible. During such rocking motion, the legs 116 urge the archwire 50aa against a latch 52aa having opposed arm portions. As the shaft 118 continues to move in the direction of the arrow, the legs 116 push the archwire 50aa against the latch 52aa with sufficient force to release the archwire 50aa from the archwire slot as shown in Fig. 7.

The hand instrument 110 is an advantage, in that the cam section 118 bears against the appliance 30aa as the archwire 50aa is released. Such construction helps to ensure that the appliance 30aa is not unintentionally debonded from the tooth as the archwire 50aa is pushed past the arm portions of the latch 52aa.

Optionally, the rear end 114 of the shaft 112 may be provided with a notch 122 for receiving the archwire 50aa. The notch 122 may be used if desired for placing the archwire 50aa in the archwire slot of the appliance 30x. Although movement of the archwire 50aa into the archwire slot by use of the practitioner's finger pressure directly on the archwire 50aa is efficient, there may be certain circumstances where use of the hand instrument 110 for placing the archwire 50aa in the archwire slot is desired.

A hand instrument 110a according to another embodiment of the invention is illustrated in Fig. 8. The hand instrument 110a includes a wire member 113a having a bifurcated front end portion. The front end portion of the wire member 113a presents two spaced apart legs 116a, each of which has a generally "L"-shaped configuration. A central section 118a interconnects the legs 116a.

In use of the hand instrument 110a to release an archwire from an archwire slot of a self-releasing orthodontic appliance, the legs 116a are positioned on a tooth-facing side or lingual side (for labial appliances) of the archwire. In this position, the legs 116a straddle opposite sides of the appliance. Next, the shaft 112a is rocked in a mesial-distal direction. For example, if the shaft 112a is rocked in a mesial direction, the leg 116a adjacent the mesial side of the appliance will bear against the base of the appliance while the opposite leg 116a urges the archwire to open the latch adjacent the distal side of the appliance. The rocking motion is continued in that direction until the archwire is released from the distal latch.

Next, the shaft 112a is rocked in an opposite direction, or in a distal direction in the example set out above. In that instance, the distal leg 116a bears against a distal side of the appliance base while the opposite leg urges the archwire against the mesial latch of the appliance. Continued movement of the shaft 112a opens the latch on the mesial side of the appliance and releases the archwire from the mesial latch. At that time, the archwire is fully released from the appliance and the hand instrument 110a can be removed from its position behind the archwire.

A hand instrument 110b according to another embodiment of the invention is illustrated in Fig. 9. The hand instrument 110b is somewhat similar to the hand instruments 110, 110a in that the hand instrument 110b has an elongated shaft 112b and a pair of legs 116b. However, the hand instrument 110b is an advantage, in that it is constructed from a unitary sheet of material that may be stamped and then bent to the desired configuration. For example, the hand instrument 110b may be stamped from a metallic material such as stainless steel series 400, and thus made in a relatively inexpensive manner.

A hand instrument 110c according to another embodiment of the invention is illustrated in Figs. 10 and 11. The hand instrument 110c includes an elongated shaft 112c, a portion of which is shown in the drawings. The hand instrument 110c has a single leg 116c with a generally "U"-shaped section 117c and an outer, terminal end section 119c. As can be appreciated by reference to Fig. 11, the end section 119c extends at a slight acute angle relative to the outer leg of the "U"-shaped section 117c.

An example of use of the hand instrument 110c is depicted in Fig. 11. As shown, the hand instrument 110c is positioned so that the archwire 50aa extends through the "U"-shaped section 117c, preferably so that it lies at the intersection of the end section 119c and the "U"-shaped section 117c. Next, the shaft 112c is rocked in a generally mesial-distal direction and an opposite part of the "U"-shaped section bears against the appliance 30aa. As the shaft 112c continues to be pivoted in the same mesial-distal direction, the archwire 50aa is pressed against the latch in order to open the latch and release the archwire 50aa from the archwire slot.

Next, the hand instrument 110c is disengaged from the archwire 50aa and rotated approximately 180 degrees about its longitudinal axis in order to be placed in a position opposite that shown in Fig. 11. Again, the hand instrument 110c is manipulated so that the archwire extends through the middle of the "U"-shaped section 117c. As the shaft 112c is rocked in a direction opposite to the direction of motion described above, the archwire 50aa is pressed against the remaining latch of the appliance 30aa in order to open that latch and completely release the archwire 50aa from the archwire slot of the appliance 30aa.

Another hand instrument 110d of the present invention is illustrated in Figs. 12 and 13. The hand instrument 110d is somewhat similar to the hand instrument 110 in that it includes an elongated shaft 112d and at least one, and preferably two hook-shaped legs 116d having a generally "J"-shaped configuration.

In the illustrated embodiment, the legs 116d are spaced apart from each other and extend in parallel planes that lie on opposite sides of a central cam section 118d. A pair of rivets 120d (Fig. 13) secure the legs 116d to the central cam section 118d. In turn, the central section 118d is pivotally connected to the shaft by a pin 123d.

The central section 118d also includes a series of detents 125d. The shaft 112d has a central passageway that receives a coiled compression spring 124d. A ball 126d is positioned between one end of the spring 124d and the central section 118d.

As the section 118d is moved in an arc designated by the letter "A" in Fig. 13, the ball 126d is successively received in the detents 125d. The spring 124d provides sufficient compressive force to releasably retain the ball 126d in a selected detent 125d so that the angular position of the central section 118d relative to the shaft 112d can be chosen as desired. However, the spring 124d is sufficiently flexible to enable the user to pivot the central section 118d relative to the shaft 112d when desired by exerting sufficient hand pressure on the legs 116d or the section 118d and urging the latter in a direction along the arc designated "A" to compress the spring 124d and move the ball 126d out of the detent. The legs 116d and the section 118d can then be moved along the arc "A" to the desired orientation.

The hand instrument 110d is an advantage because the angular position of the legs 116d can be selected to best match the task at hand. For example, the angular orientation of the legs 116d and the central section 118d relative to the shaft 112d as depicted by full lines in Fig. 13 may be desired in instances where an archwire is to be released from brackets that are located in posterior regions of the patient's oral cavity. By contrast, a straight orientation (wherein the legs 116d and the central section 118d extend away from the shaft 112d in a direction parallel to the longitudinal axis of the shaft 112d) may be desired for use in releasing an archwire from an appliance that is located in an anterior region of the patient's oral cavity.

The present invention is useful with other appliances as well. Examples of other appliances are described in U.S. Patent No. 6,302,688.

Claims:

1. A method of releasing an archwire from an archwire slot of an orthodontic appliance comprising:

placing at least one leg of a hand instrument along a tooth-facing side of the archwire;

manipulating the hand instrument in order to urge the archwire in a direction toward a latch of the appliance; and

pressing the archwire against the latch with sufficient force to open the latch and release the archwire from the archwire slot.

2. The method of claim 1 wherein the act of manipulating the hand instrument in order to urge the archwire in a direction toward a latch of the appliance includes the act of pivoting the hand instrument.

3. The method of claim 2 wherein the act of pivoting the hand instrument includes the act of placing a section of the hand instrument against the appliance while the hand instrument is pivoted.

4. The method of claim 3 wherein the act of placing a section of the hand instrument against the appliance includes the act of placing a section of the hand instrument against a tiewing of the appliance.

5. The method of claim 3 wherein the act of placing a section of the hand instrument against the appliance includes the act of placing a section of the hand instrument against a base of the appliance.

6. The method of claim 2 wherein the act of pivoting the hand instrument includes the act of rocking an elongated shaft of the hand instrument in a generally occlusal-gingival direction.

7. The method of claim 2 wherein the act of pivoting the instrument includes the act of bearing a cam section of the instrument against the appliance.

8. The method of claim 2 wherein the act of pivoting the hand instrument includes the act of rocking an elongated shaft of the hand instrument in a generally mesial-distal direction.

9. The method of claim 1 wherein the act of manipulating the hand instrument includes the act of moving the hand instrument in order to engage the archwire adjacent a mesial side of the appliance and also adjacent a distal side of the appliance.

10. The method of claim 1 wherein the act of moving the hand instrument includes the act of engaging the archwire adjacent a mesial side of the appliance simultaneously with the act of engaging the archwire adjacent a distal side of the appliance.

11. An orthodontic hand instrument for releasing an archwire from an archwire slot of an orthodontic appliance having a latch, the instrument comprising:

an elongated shaft;

two legs connected to the shaft, each leg having a hook-shaped configuration for engaging the archwire, the legs being spaced apart from each other; and

a cam section located between the legs for contacting the appliance while the shaft is rocked in order to press the archwire against the latch of the appliance.

12. The orthodontic hand instrument of claim 11 wherein the legs are spaced apart a distance sufficient to straddle opposite sides of the appliance.

13. The orthodontic hand instrument of claim 11 wherein the cam section bears against the appliance while the shaft is rocked in an arc about the central axis of the archwire.

14. The orthodontic hand instrument of claim 11 wherein the legs are pivotally connected to the shaft.

15. The orthodontic hand instrument of claim 14 wherein the pivotal connection between the legs and the shaft releasably retains the legs in any one of a number of positions relative to the shaft.

16. The orthodontic hand instrument of claim 11 wherein the legs and the cam section are pivotally connected to the shaft.

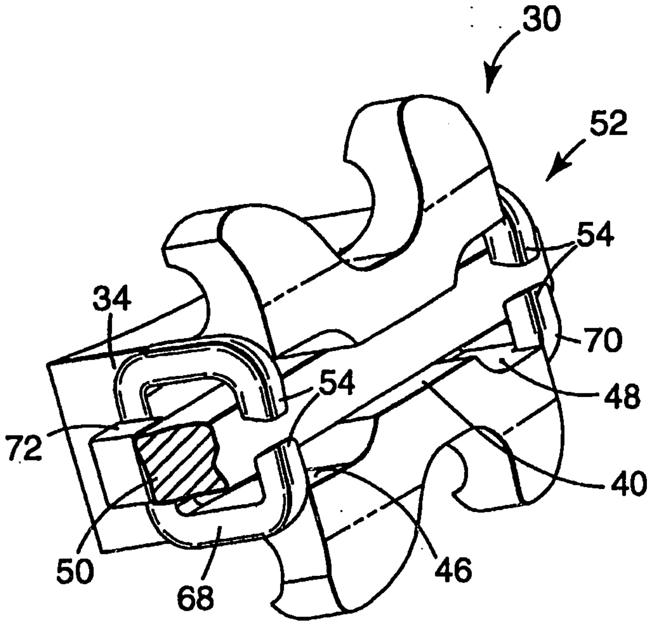


Fig. 1

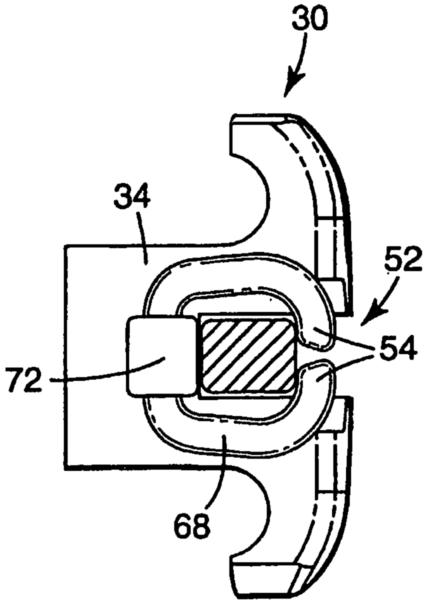


Fig. 2

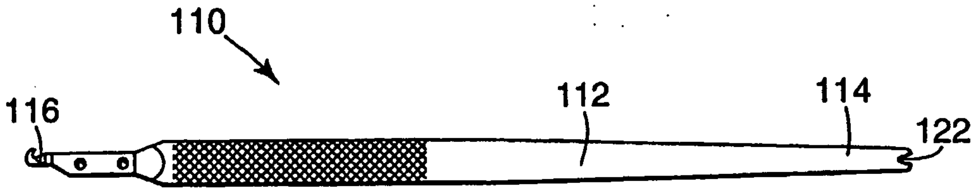


Fig. 3

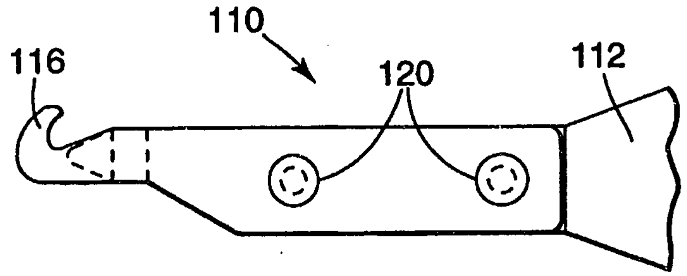


Fig. 4

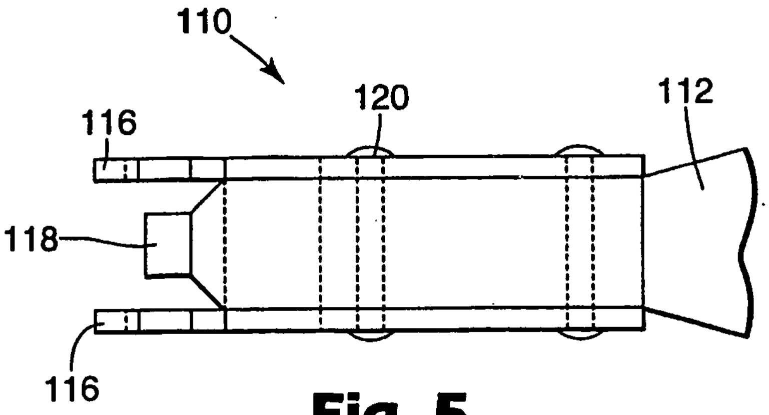


Fig. 5

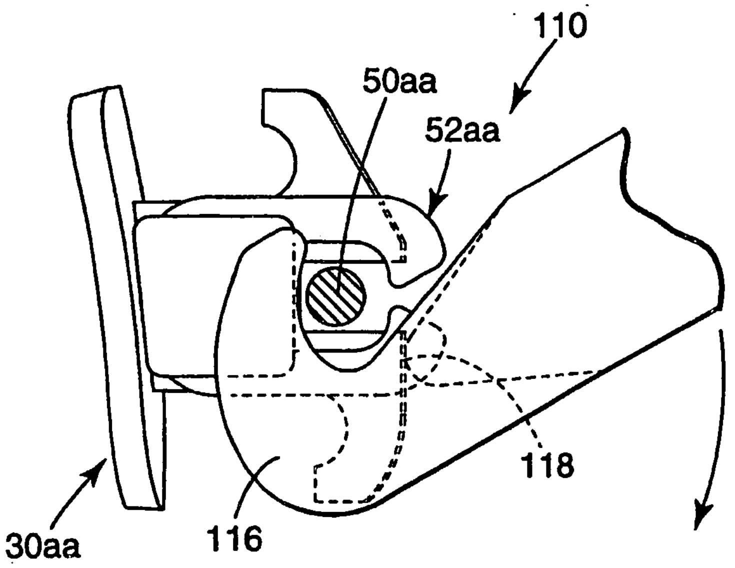


Fig. 6

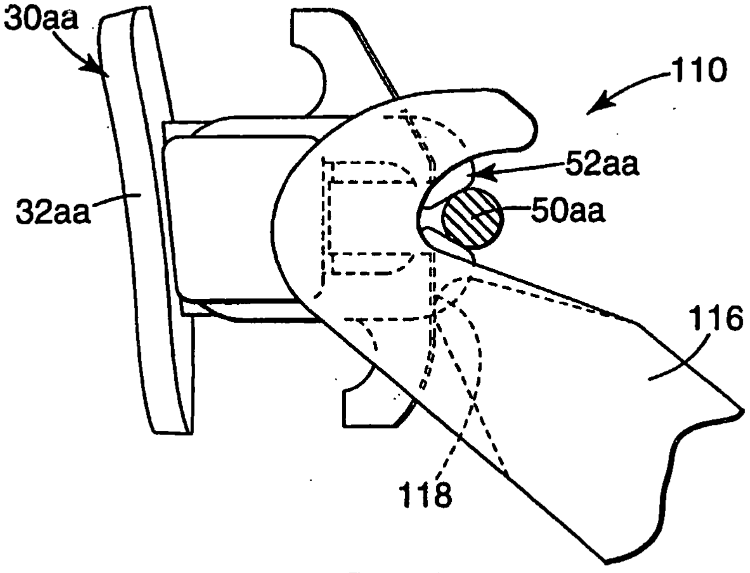


Fig. 7

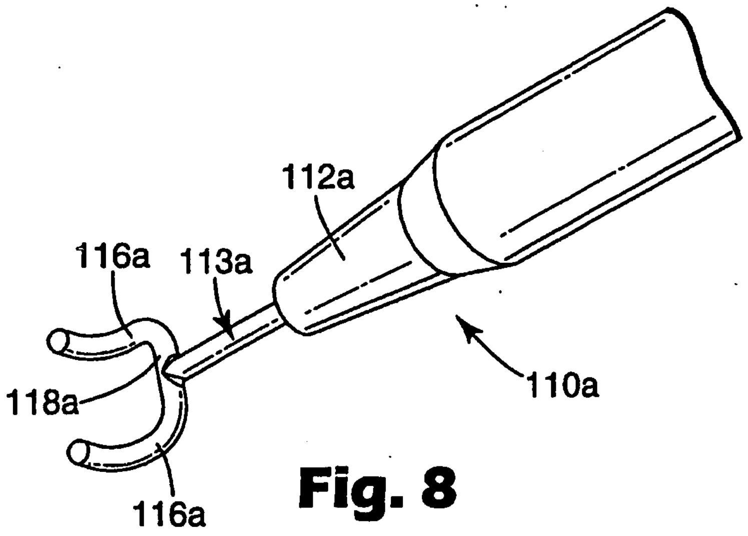


Fig. 8

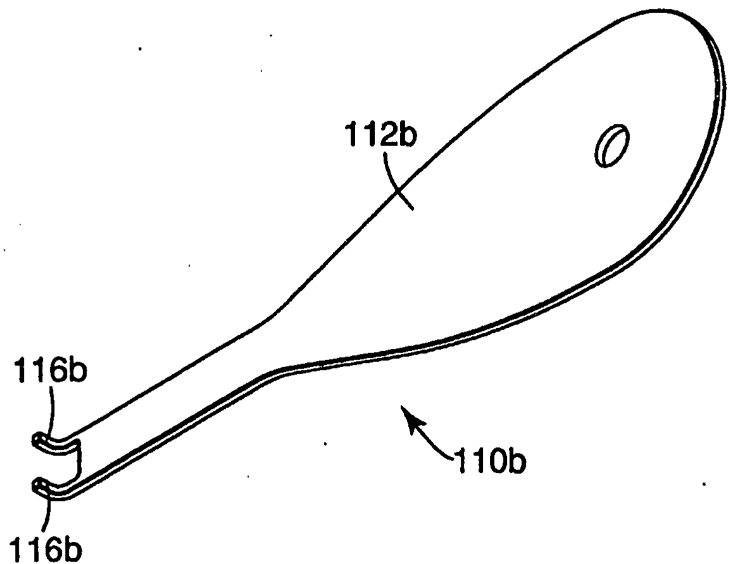


Fig. 9

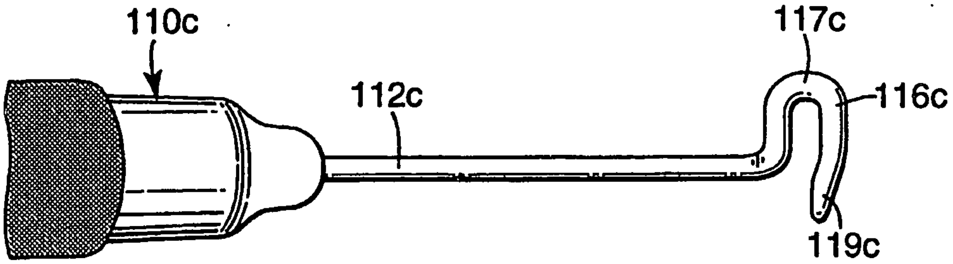


Fig. 10

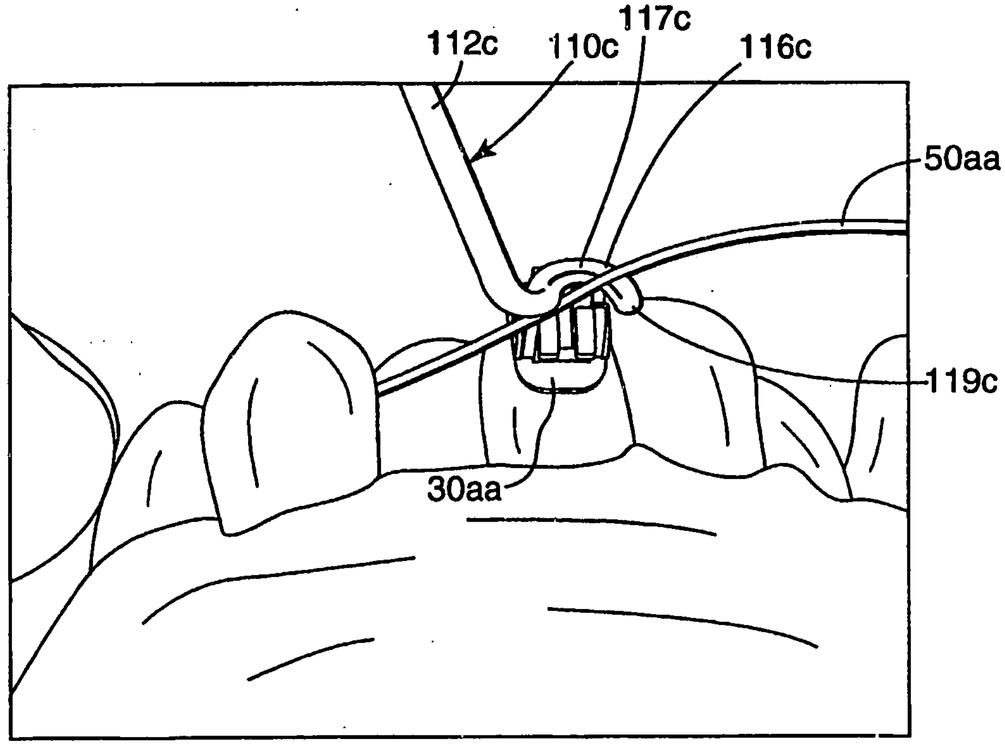


Fig. 11

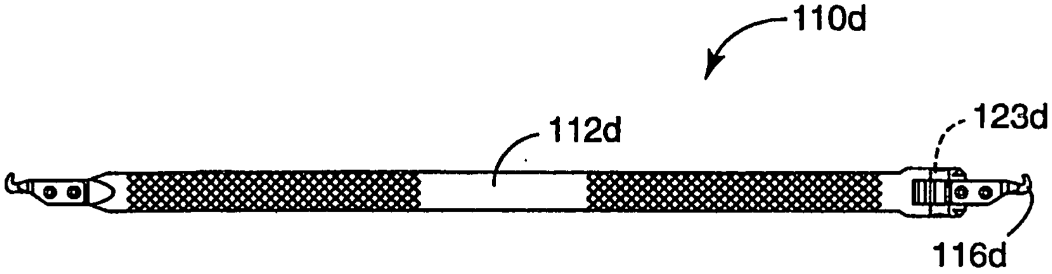


Fig. 12

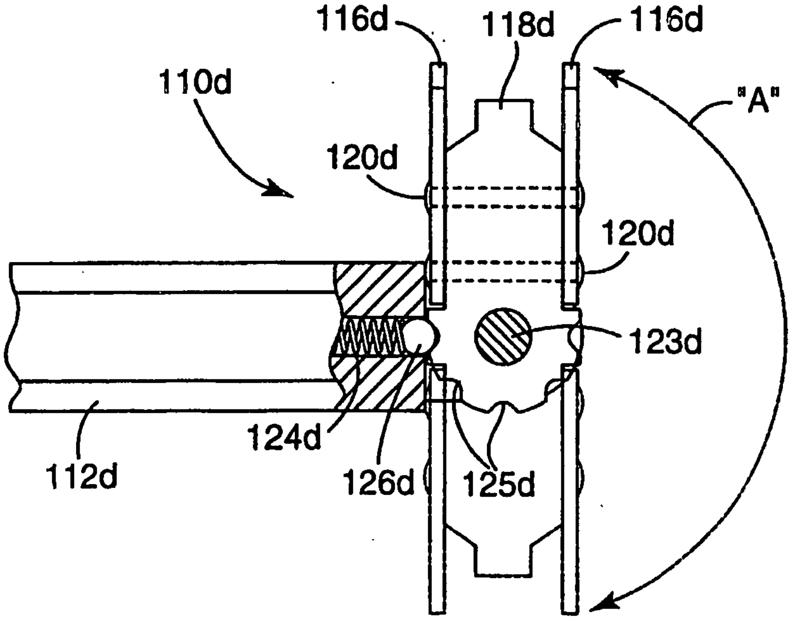

"A"

Fig. 13